Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Amendment of Part 2 of the Commission's Rules	)	
for Federal Earth Stations Communicating with	)	ET Docket No. 13-115
Non-Federal Fixed Satellite Service Space	)	
Stations;	)	RM-11341
	)	
Federal Space Station Use of the 399.9-400.05	)	
MHz Band; and	)	
	)	
Allocation of Spectrum for Non-Federal Space	)	
Launch Operations	)	

30 August 2013

To: The Commission

COMMENTS OF BLUE ORIGIN

Blue Origin, LLC ("Blue Origin" or "Blue"), pursuant to Sections 1.415 and 1.419 of the Commission's rules (47 C.F.R. §§ 1.415 & 1.419) respectfully submits these Comments in the above-referenced proceeding. In support of these Comments, Blue Origin submits:

About Blue Origin:

Blue Origin is actively developing commercial space launch vehicles for both suborbital and orbital applications. We are primarily focused on human spaceflight, but we also plan to carry payloads to space.

Blue Origin is engaged in an incremental, long-term development program pioneering vertical-powered landing, so that launch vehicles can be recovered and reused for dramatically lower cost and enhanced safety. Blue Origin's rocket-powered prototype vehicles are in active flight testing at our West Texas Launch Site, using frequency licensed by FCC without causing

any unwanted interference in spectrum usage. Blue Origin and its affiliate own the 18,600 acre West Texas Launch Site. To the best of our knowledge, Blue Origin is the only commercial company that operates its own private space launch site. Our design and assembly area is at our 26 acre site in Kent, Washington (in the Seattle area), also owned by Blue Origin and its affiliate.

Blue Origin partnered with NASA under the Commercial Crew Development (CCDev) programs. In CCDev 1, we tested a composite pressure vessel (capsule) for human spaceflight, and an innovative thrust vector control (TVC) system for rapid human escape from a launch vehicle.[1] We have continued this partnership with NASA under the CCDev 2 program, with further ground and flight testing of the escape system TVC.[2] CCDev 2 activities also include testing a new 100,000 lbf. liquid oxygen/liquid hydrogen deep-throttling rocket engine at both NASA's Stennis facility and at Blue Origin's facility. This new engine is being developed specifically to enhance human spaceflight and vertical powered landing. Our CCDev 2 work with NASA also included a System Requirements Review, including radio frequency (RF) communication requirements, of our biconic orbital Space Vehicle (similar to a capsule) for transporting humans during launch, Earth orbit, reentry, and landing, as well as development of a Space Vehicle to Atlas V Interface Definition Document for launch from Cape Canaveral.

Blue Origin is currently expanding its facilities to include a coastal site for orbital launch activities. In the course of this site selection, we are actively considering both federal launch sites (such as Cape Canaveral/Kennedy Space Center, Florida and Wallops Island, Virginia) as well as potential non-federal sites (such as in Georgia, Texas, Space Florida's proposed "Shiloh" commercial launch site in the Cape Canaveral area, and other areas).

[1] Further information about Blue Origin's CCDev 1 partnership with NASA is available on NASA's website at: http://www.nasa.gov/offices/c3po/partners/blueorigin/index.html

[2] A copy of Blue Origin's Space Act Agreement with NASA can be found on NASA's website at: procurement.ksc.nasa.gov/documents/SAA_BlueOrigin_04-18-2011.pdf. Appendix 1 to this Space Act Agreement contains an Executive Summary of Blue Origin's CCDev 2 activities.

As a result, Blue Origin offers the following comments on spectrum allocation based on a wide breadth of space launch development activities: orbital and suborbital, at federal and non-federal ranges, carrying humans and payloads, for commercial and federal customers.

To ease FCC review, we have also included the paragraph number from FCC's Notice of Proposed Rule Making (NPRM)/Notice of Inquiry (NOI), as originally published by the FCC on March 9, 2013. (Since the paragraph numbering in FCC's NPRM/NOI published on May 9, 2013 differs from the numbering published in the July 1, 2013 Federal Register, we have sometimes included the *full text of FCC's NPRM/NOI paragraph in italics* for ease of FCC's reference.) However, please note that any individual comment may apply more broadly than the particular FCC paragraph number referenced.

NPRM

FCC Paragraph 73:

Blue Origin comment: Blue Origin was founded in 2000, and is an active member of the commercial space transportation launch operator industry in the United States. Blue Origin has undertaken flight testing of space launch vehicles, has partnered with NASA in the CCDev 1 program, and is currently partnered with NASA in the CCDev 2 program. Blue Origin has less than 1,000 employees. Blue Origin operates what we understand to be the only private, commercial space-launch site in the United States.

FCC can learn of additional members of the commercial space launch industry by contacting the Federal Aviation Administration (FAA), Office of Commercial Space Transportation (AST), and the Commercial Spaceflight Federation, both located in Washington, D.C.

FCC Paragraph 77:

> *77. The 420-430 MHz band is allocated on a primary basis for Federal radiolocation and on a secondary basis for the non-Federal amateur service.153 Federal radiolocation use of the band is restricted to the military services.154 Portions of the band are also allocated on a primary basis for the non-Federal land mobile service at three locations.155 The band may also be used for low power Federal radio control operations.156 The International Table contains primary fixed and mobile, except aeronautical mobile, allocations and a secondary radiolocation allocation. Because the only non-Federal allocation for the 420-430 MHz band is for secondary amateur operations, the Commission cannot issue licenses that provide interference protection to commercial entities to use this band for self-destruct signals during launches. Commercial entities have not requested experimental STAs or licenses from the Commission for self-destruct signals in the 420-430 MHz band to date. In this regard, we seek comment on the requirements associated with command and destruct communications for commercial launch vehicles and whether access to the 420-430 MHz band is necessary. The commercial launch vehicle has only a receiver for the self-destruct signal and therefore does not require a license to transmit. If the self-destruct signal is being transmitted from a government owned facility using equipment under the control of Federal Government employees, no license from the Commission would be required. Instead, an authorization from NTIA would be needed.*

Blue Origin comment: We anticipate that Blue Origin and other commercial launch operators will need access to the 420-430 MHz band for command and destruct communications. We anticipate that privately-owned transmission facilities will be used for such operations, both for operations conducted on federal ranges and those conducted at non-federal ranges. To be cost effective, a launch vehicle operator needs to use compatible equipment regardless of whether the payload is commercial or government, or whether the launch facility is commercial or government. Any commercial licensee of the 420-430 MHz band would need to be able to demonstrate robustness of the equipment and frequency link. Commercial launches are overseen by FAA/AST, which (as part of its safety evaluation) will seek a track record of development tests showing the same equipment and links being used. For a federal mission, US Government

range safety oversight will seek a similar prior track record of robustness in commercial launches. Forcing vehicle operators to arbitrarily switch frequencies would complicate any safety review and potentially create an unnecessary safety hazard. FCC should consider coordinating with FAA/AST on any requirement for launch vehicle operators to use different communication equipment and frequency bands for federal and non-federal launches. We strongly suggest FCC not create any artificial distinctions between equipment and frequency used for federal launches and for non-federal launches.

FCC Paragraph 79:

> ***79.*** *2200-2290 MHz. The 2200-2290 MHz band is used for launch telemetry - i.e. the sending of information from the launch vehicle to ground controllers during the launch. We propose two alternative approaches that would provide commercial launch operators access to spectrum in the 2200-2290 MHz band for launch telemetry. As a first alternative, we propose to add a footnote to the Allocation Table providing primary non-Federal space operation service allocations to portions of the 2200-2290 MHz band for launch telemetry. This footnote would require successful coordination of the assignment and use of the band for space launches with NTIA, would restrict non-Federal use of the band to pre-launch testing and to use at Federal ranges, would limit non-Federal use of the band to the 2207-2219 MHz, 2270.5-2274.5 MHz, and 2285-2290 MHz portions of the band, and would limit non-Federal use of the band to channels with bandwidth of less than 5 MHz based on our understanding of current usage. As a second alternative we propose to amend the Allocation Table to add a non-Federal Space Operations allocation to the 2200-2290 MHz band. This allocation would be accompanied by a footnote to the Allocation Table with the same restrictions specified in the footnote proposed in the first alternative. We seek comment on these two alternative proposals. Which alternative would be better suited to meeting our goal of providing access to spectrum during launches for launch telemetry?*

Blue Origin comment: Commercial launch operators will make use of the 2200-2290 MHz band at both (i) federal ranges, using both federal and non-federal communication assets, and (ii) at non-federal ranges. We suggest FCC adopt a non-federal co-primary allocation of this frequency band. The FCC's proposed restriction to use this band at

only federal ranges conflicts with FCC's past practice in experimental licensing for launch-related radio activities. Various launch providers conducting mostly non-federal launch missions are currently using, or actively contemplating, launch operations outside of the federal ranges. Commercial launch operators operating from non-federal ranges should not be placed at a disadvantage vis-à-vis commercial launch operators launching from a federal range.

FCC Paragraph 81:

> ***81.*** *The 2200-2290 MHz band is heavily used by Federal agencies. We seek comment on whether there is sufficient spectrum available in this band for use during commercial launches, and, in particular, whether the use of this band could sustain the anticipated growth of the commercial launch sector. Using the same frequencies for Federal and non-Federal launches has distinct advantages for the commercial space industry. The equipment used for communications during launches has been developed and is reliable. Launch communications have successfully shared this band with the other services present for numerous launches through coordination of the various operations. Many commercial launches will occur from facilities co-located with Federal launch sites such as Cape Canaveral or Vandenberg Air Force Base where this sharing has been accomplished. In the future, the same companies will likely conduct launches for both Federal agencies and private entities and eventually likely transition to commercial space ports that are completely independent of Federal operations. We seek comment on whether requiring industry to have the capability to conduct communications in different bands depending on whether the launch is considered Federal or non-Federal would place an expensive burden on these companies.159 Providing access to spectrum that can sustain the short and long term needs of the commercial launch industry is in accordance with the policy of the United States government to develop a vibrant commercial space industry.160*

Blue Origin comment: At least three launch companies are already using 2200-2290 MHz telemetry downlinks, and each launch typically uses multiple links each of several megahertz or more. Given this rapid increase in use of the 2200-2290 MHz bands by commercial launch operators, we project additional spectrum will soon be needed to support future commercial launch operations.

Any frequency allocation should be open to all commercial launch operators, regardless of whether or not they are operating from a federal range. Commercial launch operators are contemplating operating the same launch vehicle from a variety of launch locations, including federal ranges, commercial spaceports located inside or adjacent to federal ranges, and non-federal ranges far from any federal range. Each of these launches may carry federal or non-federal payload or humans, depending on the mission. For example, a federal payload may be launched from a non-federal range, and a non-federal payload may be launched from a federal range. Launch vehicle operators seek to use the same vehicle and concept of operations (ConOps) across these various launch locations, including the same communications equipment. We suggest FCC rules allow each launch vehicle operator to use whatever spectrum they are licensed, regardless of whether at a federal or a non-federal range.

FCC Paragraph 82:

> ***82.*** *In both of the alternative proposals we have proposed that non-Federal use of the bands for space launches be limited to the 2207-2219 MHz, 2270.5-2274.5 MHz, and 2285-2290 MHz portions of the band. We have proposed this limitation based on our understanding of current usage. We seek comment on limiting non-Federal use to these portions of the band for space launches. Can limiting non-Federal use to this portion of the band support the expected growth of the commercial launch industry? We have also proposed to limit non-Federal use of these bands to communication channels with bandwidths of less than 5 megahertz based on our understanding of current usage. We seek comment on this limitation. In addition, we have proposed to limit non-Federal use of this band for space launches to pre-launch testing and for launches conducted at Federal ranges. We propose this restriction to limit the potential for interference to Federal operations to a few locations. As the commercial space ports are established that are independent of Federal operations would this restriction unduly limit the future growth of the commercial space launch industry?*

Blue Origin comment: FCC has already granted commercial launch operators use of the 2200-2290 MHz band (outside of the 2207-2219 MHz, 2270.5-2274.5 MHz, and

2285-2290 MHz portions of the band) for launches from non-Federal ranges. We project that growth of total commercial launch operations will quickly exceed the capacity of the 2207-2219 MHz, 2270.5-2274.5 MHz, and 2285-2290 MHz portions of the band. We suggest FCC not limit use of the 2200-2290 MHz band to the 2207-2219 MHz, 2270.5-2274.5 MHz, and 2285-2290 MHz portions of the band for launches for non-federal use, as doing so would impose operations restrictions and undue expense on some commercial launch vehicle operators. In particular, such a restriction would unduly limit the growth of commercial spaceports, as well as creating an additional burden on companies that seek to conduct both federal and non-federal launch operations using the same vehicles and ground support equipment.

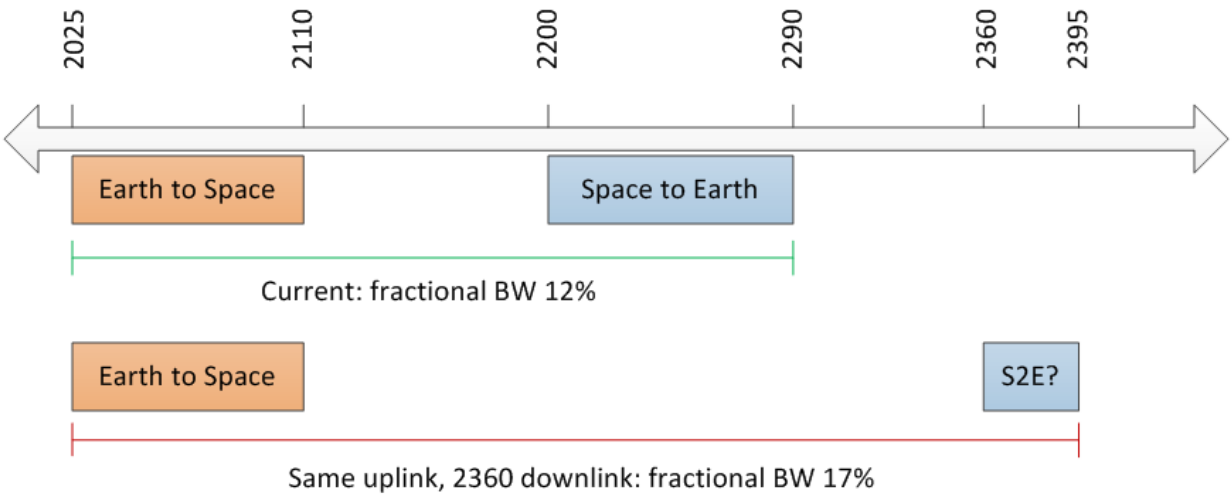
The 5 MHz bandwidth restriction appears reasonable, and a practical means of accommodating spectrum access by multiple commercial launch vehicle operators.

FCC Paragraph 83:

> ***83.*** *As mentioned above, in 1990 the Commission made six frequencies in the 2310-2390 MHz band available for both Federal and non-Federal use for telemetry and telecommand of launch and reentry vehicles.161 The Commission later reduced these to three frequencies in the 2360-2395 MHz band.162 The 2360-2395 MHz band is primarily used for aeronautical telemetry and telecommand operations for flight testing of aircraft and missiles.163 We seek comment generally on the use of these frequencies as an alternative to the heavily used 2200-2290 MHz band for communications during launches. In the time since the Commission made this spectrum available for launch telemetry, the intensity of use of this band for aeronautical telemetry for flight testing may have significantly changed. Does the current and expected future use of the 2360-2395 MHz band for aeronautical telemetry for flight testing make it unsuitable for communications associated with launch activity? What are the impediments to use of this band for commercial launches in the future? What are the spectrum requirements of the commercial launch sector in the short and long term and are the available frequencies in this band sufficient to meet, at least in part, these requirements? Because the number of frequencies available for launch vehicle telemetry and telecommand has been halved, would the needed data capacity be available for telemetry and telecommand during commercial launches? Should the Commission make the entire 2360-2395 MHz band available for telemetry and*

telecommand during commercial launches? Will the development of communications equipment for use on launch vehicles for this band place a significant economic burden on the commercial space industry? Prior to the Commission making frequencies in the 2310-2395 MHz band available for space launch telemetry, several commenters stated that it would be more cost efficient to use the same frequencies for both Federal and non-Federal launches and that the band should not be used until all Federal launch facilities had transitioned to the band. 164 We seek comment on whether these concerns are still valid. Are there other reasons why the 2360-2395 MHz band is not a viable alternative to the 2200-2290 MHz band for telemetry during launches?

Blue Origin comment: We encourage FCC to allow use of the entire 2360-2395 MHz band for commercial launch operations, including both telemetry and telecommand (with suitable segregation). We suggest licensing of the 2360-2395 MHz band allow for using a single antenna for uplink and downlink. Commonly available antennas can currently cover both the 2025-2110 MHz and 2200-2290 MHz bands with a 12% fractional bandwidth. However, if the same uplink is paired with a downlink in the 2360-2395 MHz band (and only one set of antennas is to be used), the antenna must have 17% fractional bandwidth. If the 2360-2395 MHz band is to be used for downlinks, FCC should make an additional nearby band available for uplinks. An example is given below:



Please note that, if commercial launch operations are confined to using only the 2360 - 2395 MHz band for both uplink and downlink, the allocations will run out of room because the 2360-2395 MHz band is much smaller than the combination of 2025-2110 MHz and 2200 - 2290 MHz.

We agree that, if the entire band is made available for commercial launch operations, then it should remain co-primary with aeronautical telemetry.

It is not cost-prohibitive for a launch operator to use the 2360-2395 MHz band, as long as the operator is able to use the same allocated spectrum for both federal and non-federal launches. Readily-available commercial communications equipment is designed for frequency translation from an intermediate frequency signal to a final transmission frequency. Frequency translators that operate on alternative RF transmission frequencies can easily be paired with the same intermediate frequency baseband equipment. FCC should not constrain the commercial launch industry to an already-crowded band when minor technical hurdles are easily solved, such as by using readily-available equipment.

FCC Paragraph 84:

> ***84.*** *Looking beyond the 2360-2395 MHz band, we seek comment on alternatives to the use of the 2200-2290 MHz band for launch communications. We realize that as the demand for spectrum has increased, finding spectrum for new applications has become more difficult. That is especially the case for an application such as the space operation service, which involves transmitting high powered signals from high altitudes that may result in interference over a large area. Because these communications will take place from space, must the spectrum used be internationally allocated to the space operation service (space-to-Earth)? There is meager spectrum allocated for this purpose.165 Assuming that another suitable frequency band could be identified, would obtaining an international space allocation be a long process with uncertain success?*

Blue Origin comment: Any alternative bands for launch communications should be internationally allocated to space operation service. Orbital operations will require use of the same band while operating over large sections of the Earth. Even suborbital operations will be at such high altitudes that they will likely impact frequency allocation in neighboring countries such as Canada and Mexico.

FCC NOTICE OF INQUIRY:

FCC Paragraph 88:

> ***88.*** *While the commercial space operations portion of the NPRM has focused on use of the 420-430 MHz, 2200-2290 MHz, and 5650-5925 MHz bands during launches, we understand that the commercial space industry may have additional needs for spectrum in the future. In this Notice of Inquiry, we launch an inquiry into the future spectrum requirements of the commercial space industry. We seek comment broadly on what other spectrum needs may be important as the commercial space sector continues to develop. What spectrum will be required as commercial spaceports are developed where the established communications infrastructure that is in place at the government-owned launch facilities is not present? Are there communications needs during other portions of space missions after the launch such as during re-entry or the "on orbit" phase of a mission that require changes in allocations? Are there any other frequency bands, whether Federal, non-Federal, or shared that the commercial space industry will need access to? Can some of the spectrum needs of the commercial space industry be satisfied by purchasing or leasing spectrum from other licensees? Are there any portions of the Commission's rules that will need to be amended to keep pace with this rapidly changing industry?*

Blue Origin comment: There are various other space-to-Earth and Earth-to-space bands in use (including use under Experimental Licenses), such as 401-402 MHz for low rate data telemetry. Commercial human-carrying spacecraft under development, such as capsules and vehicles transporting humans on orbit, will become a new form of 'satellite' around the Earth and may benefit from various bands currently used by the satellite industry, such as bands in the region of 4 - 7 GHz. For example, satellite bands for video may also be relevant for video and other communications from human-carrying spacecraft on orbit. Also, human-carrying

spacecraft may seek to use satellites to communicate with ground stations on the far side of the Earth, to maintain continuous coverage as a spacecraft obits the Earth. As a result, human-carrying spacecraft transmissions will be similar to (and sometimes using) satellite transmissions. FCC should consider (i) licensing human-carrying spacecraft with the same bandwidth currently used by satellites, and (ii) expanding the permissible use of satellite bandwidth licensing to include transmissions to and from human-carrying spacecraft.

FCC Paragraph 90:

> ***90.*** *Bigelow Aerospace has announced plans to have a commercial space station in orbit as early as 2016. Presumably, a space station with human habitation will need reliable communications with earth based ground stations. We seek comment generally on the communications needs of such a space station. Will additional allocations of spectrum be necessary to support a commercial space station? What modifications to the Commission's rules will be needed to support the communication needs of the space station?*

Blue Origin comment: The spectrum needs of a commercial space station will often be identical to the spectrum needs of spacecraft transporting humans to, in and from orbit, whether that transport is to a space station or otherwise. Please see comments above (in response to inquiry paragraph number 88) related to the spectrum needs of these human-carrying spacecraft.

For the reasons set forth herein, Blue Origin requests that the FCC adopt the proposals submitted herein. We thank the FCC for its in-depth review of the communication needs of the commercial spaceflight industry, and welcome further discussion with FCC concerning the allocation of spectrum to best meet these needs.

Respectfully submitted,

BLUE ORIGIN, LLC